

RECLAMATION AT VERNAL PHOSPHATE OPERATIONS

PRIOR TO 1983

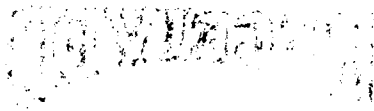
Compiled By
D. K. Bassler
Fall 1982

CHEVRON RESOURCES COMPANY
VERNAL PHOSPHATE OPERATIONS
VERNAL, UTAH

RECEIVED

APR 4 1984

DIVISION OF
OIL, GAS & MINING



RECEIVED
LIBRARY OF CONGRESS

TABLE OF CONTENTS

Introduction	1
Reclamtion Methods & Results	
Fall 1976 Panel 1	2
Fall 1976 Panel A	4
Fall 1978 Panel A	4
Fall 1979 Panel A	6
Fall 1980 Panel A	8
Fall 1981 Panel A	9
Fall 1981 Brush Creek Haul Road Area SW of Brush Creek Fill	9
Spring 1982 Panel C	10
Spring 1982 Panel C Topsoil Stockpile	10
Spring 1982 Roadside Areas	10
Spring 1982 Panel 1	11
Summer 1982 Area West of Office	13
Summer 1982 Tailings Bench	13
Summer 1982 Brush Creek Topsoil Stockpile	14
Fall 1982 Brush Creek Fill Slopes	14
Fall 1982 Brush Creek Haul Road Area NE of Brush Creek Fill	14
Drainage Field	15
Area NW of Office	15
Fall 1982 Panel A	15
Fall 1982 Lower Panel A Below Fuel Dump	16
Discussion	17
Acknowledgements	20
Appendix I	21
Appendix II	26
Appendix III	31
Maps	

INTRODUCTION

Reclamation at the Chevron Resources Vernal Phosphate Operation has become an ever increasing part of the mining sequence since 1976. Accomplishments for re-seeding alone have increased from a low of 10 acres for the 1976 season to 87 acres for the 1982 season. Many of the areas reclaimed include pre-1975 disturbances even though Chevron has no legal obligations to do so. Chevron's objectives are to return the post mined areas to the same quality if not better than the pre-mining situation for wildlife habitat and stock grazing and to retain the natural beauty of the area.

Both Stauffer Chemical, previous operator, and Chevron have set up study areas to develop and determine the best planting mixture and methods for the conditions present at the mine. The study areas provide many different factors which affect revegetation of the mined areas. Many of these factors are not totally understood and remain to be examined in the future. Numerous studies, methods and areas have been examined which are shown in the included figures and in the Reclamation Orientation Map. Because of difficulty in describing in a general format, this report has broken down the methods and results chronologically and by season of planting for each area or study. The seed mixtures used for all past efforts are listed in Tables 1-9 of Appendix I.

A compilation of all species planted, methods used and results achieved, in table form, is found in Appendix II. All species in the test and in appendices are listed by common name, therefore, a listing of common and botanical names appears in Appendix III since common names often vary with local.

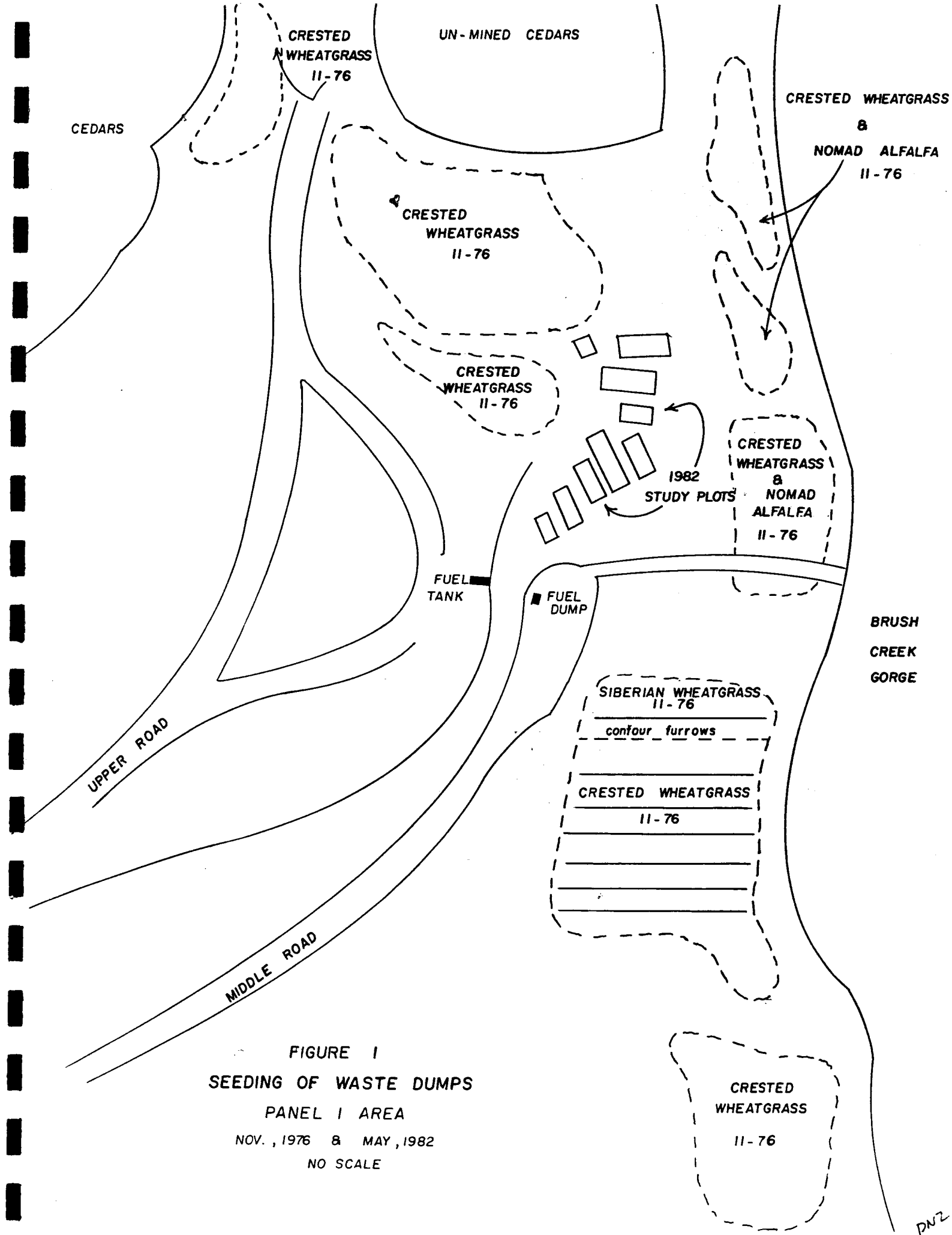
FALL 1976

Panel 1

Methods - Waste dumps were recontoured to a close proximity of the original terrain which left a grade of approximately $2\frac{1}{2}$:1 on sloped areas. The areas that were not too steep were drilled with a Rangeland seed drill and the others were broadcast by hand then dragged. Contour furrows were placed in one section that was exceptionally steep. The wheatgrass seed (Crested and Siberian) was planted in monocultures at 8 lbs/acre each. In addition, Nomad alfalfa was planted in several areas in a mixture with the Crested wheat (2 lb/acre alfalfa with 8 lb/acre Crested). Figure 1 shows area of seeding and the species planted.

Results - After having 5 full growing seasons and part of another, these plantings have shown very good success with the mixture of Crested wheat and Nomad alfalfa. The cover achieved is approximately 85% with even distribution over the entire area. The seed produced in these areas has been dispersed naturally and a good cover is naturally being achieved in surrounding, unplanted areas.

The sections planted in monocultures of the grasses, Crested and Siberian wheatgrass, have shown very little success. Most of the area planted in Siberian wheat has been redisturbed, so if success was achieved it has been alleviated. The contour furrows have naturally disappeared and can not be found.



Panel A

Methods - Recontouring to a grade of $2\frac{1}{2}:1$ or less of two waste dumps was done to develop planting areas for monocultures of Siberian wheatgrass, Luna Pubescent wheatgrass and Indian Ricegrass. The Siberian wheatgrass was drilled at a rate of 8 lbs/acre and the Luna Pubescent wheatgrass and Indian Ricegrass were hand broadcast at a rate of 8 lbs/acre and 2 lbs/acre respectively. These areas were dragged after seed was spread. (See figure 2)

Results - All of these monocultures have shown success and are seeding into surrounding areas after 5 full growing season and part of another.

FALL 1978

Panel A

Methods - The Division of Wildlife Resources (DWR) and the Soil Conservation Service (SCS) set up several plots to find seed species and seed development locations best adapted to the conditions present at the Vernal Phosphate Operations. The DWR area consisted of several rows which were seeded in sections with different seed species, varieties or seed collected from various locations. This was done in a rectangle shape on the top of a knoll that was later flattened by a dozer then seeded and covered by hand. The seeding rate was unknown. The area immediately around this rectangle was broadcast with a cyclone seeder at a composite rate of 18 lbs/acre then a pipe harrow was dragged to cover the seed.

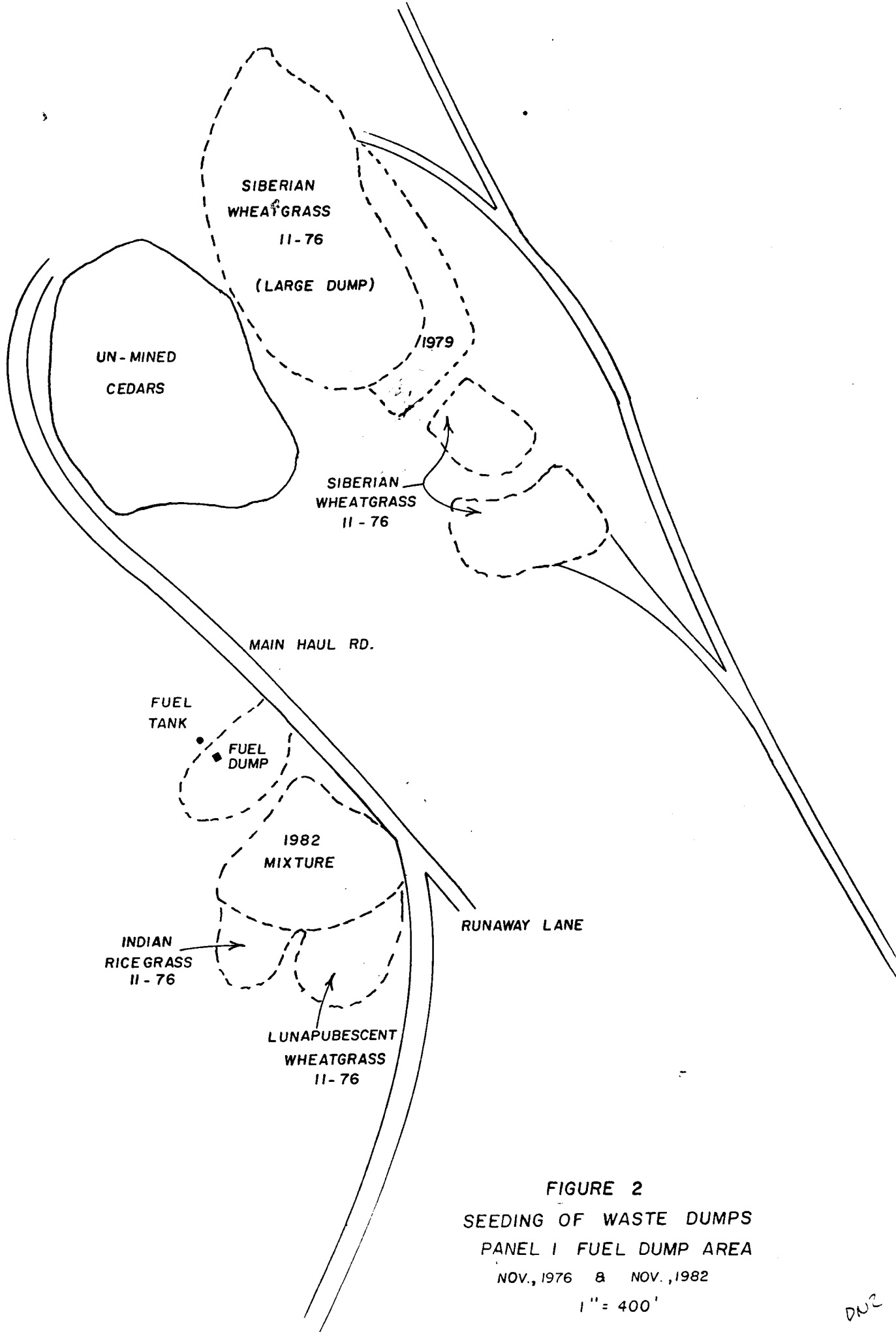


FIGURE 2
SEEDING OF WASTE DUMPS
PANEL I FUEL DUMP AREA
NOV., 1976 & NOV., 1982

1" = 400'

DN2

The SCS area was divided into 11 separate units with 2:1 slope facing all directions but north. Each unit was planted with different combinations of species and rates of applications, many of which were not recorded, but most rates are believed to have been exceptionally high. The seed was broadcast with a cyclone seeder then dragged with a pipe harrow. (See figure 3).

Results - The DWR area showed exceptional success after 4 growing seasons. Only 8 species or varieties of approximately 45 did not show growth. The area around the individual species rows had success in 7 out of 11 species. Unsuccessful species included 1 grass, 2 forb and 1 shrub species.

The success of the SCS sections was quite good also. The best results were obtained with Whitmar wheatgrass, Indian Ricegrass Cicer Milkvetch, and Ladak alfalfa. Moderate results were obtained with Luna Pubescent, Sodar Streambank and Intermediate wheatgrasses, Big Bluegrass, Basin Wildrye, Lahonton alfalfa and Yellow Sweet Clover.

FALL 1979

Panel A

Methods - Test strips were set up directly below the Siberian wheatgrass plot of 1976. These strips are oriented on a $2\frac{1}{2}$:1 slope facing east to southeast. Some terraces were made in this area. Macentire Tongue was placed over the graded overburden. These strips were developed

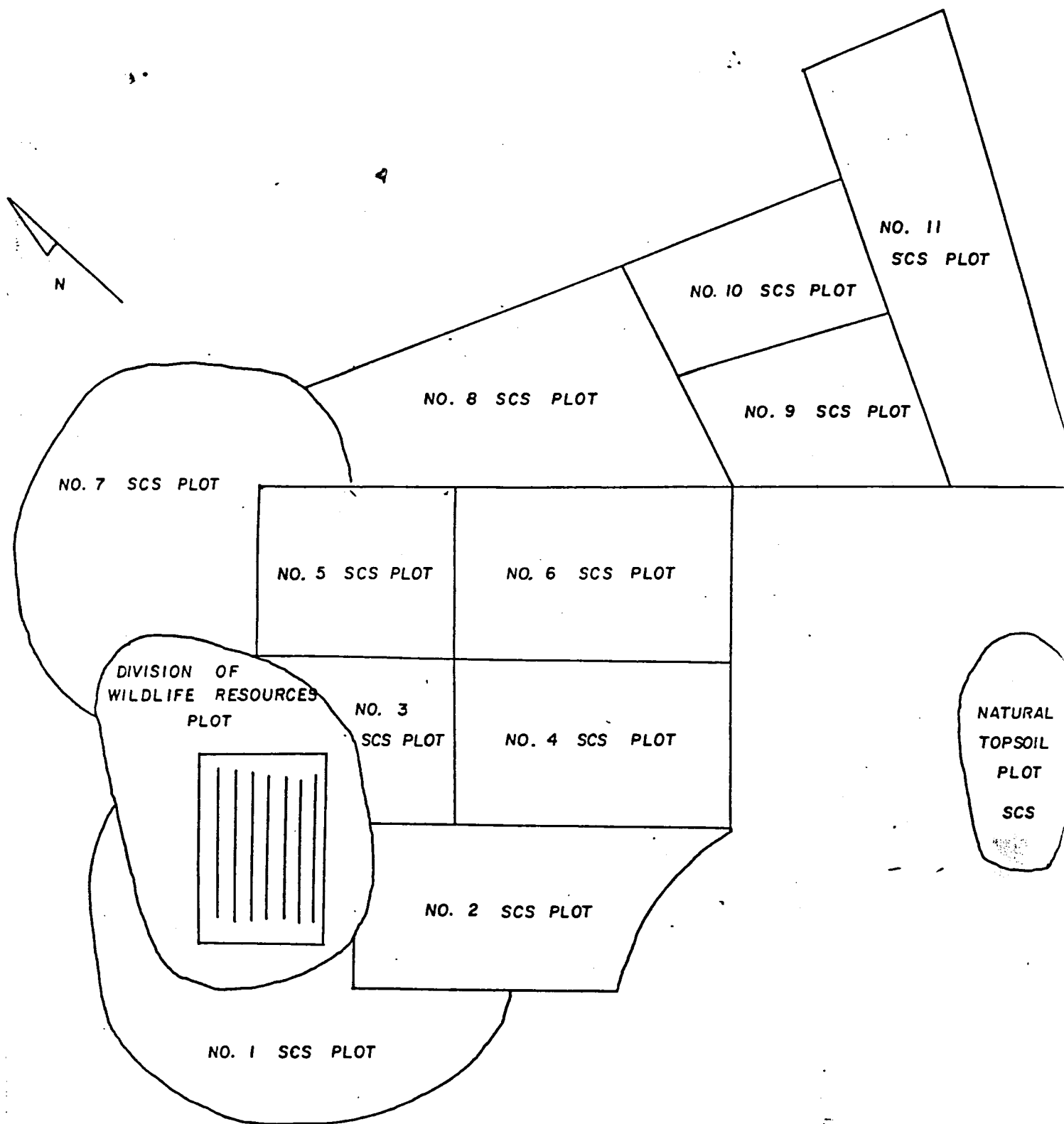


FIGURE 3
 DIVISION OF WILDLIFE RESOURCES
 &
 SOIL CONSERVATION SERVICE
 PANEL 'A' TEST PLOTS
 PLANTED 11-9-78 NO SCALE

to establish results gained from use of straw mulch and fertilizer on grass and shrub seed mixtures, at the time of planting. The strips were arranged as follows: seed mix, seed mix and fertilizer, seed mix and straw mulch, seed mix, fertilizer and straw mulch. These were repeated with both seed mixes and a combination of the two. The area was ripped with a grader to the depth of 2'-3' then straw mulch and fertilizer was applied so they would be incorporated by the seed drill as it went over the area. The grass mixture was applied at 25lb/acre and the shrub mixture was applied at 13 lbs/acre. (See figure 2).

Results - After 3 seasons' growth, the mulched strips showed substantially increased establishment of both seed mixtures. In the shrub mix locations noticeable germination of Antelope Bitterbrush took place in mulched areas but not in the others. A small difference was noted in the strips which had fertilizer applied only with the grass mix.

FALL 1980

Panel A

Methods - Seed was drilled in 26 acres, which had been recontoured so the appearance was close to the surrounding terrain. A majority of the area was covered with native topsoil or Mackentire 'Red Beds' Tongue. The area was scarified with a grader then drilled at a rate of 24.5 lbs/acre. Some areas were left rougher than others.

Results - Ladak alfalfa, Yellow Sweet Clover and Prostrate Summer Cypress were found to have the best success after two growing seasons. The other species which were planted showed some success but seemed to have heavy competition from the dominant species of alfalfa and sweet clover. The best results were obtained by all species in the rougher areas.

FALL 1981

Panel A

Methods - The tailings bench area, making up approximately 2.3 acres, was smoothed. It was then seeded at a rate of 24.8 lbs/acre with a rangeland drill.

Results - The growth in this area was very poor. It was reseeded in the summer of 1982.

FALL 1981

Brush Creek Haul Road

Area Southwest of Brush Creek Fill

Methods - The seeding and preparation for this area 7.8 acres, was the same as the other seeding done at this time except native topsoil was abundant in this area. This area was seeded at 24.8 lbs/acre with a rangeland drill. The area north of the road, which was seeded, contained a topsoil stockpile which was redisturbed in the spring of 1982.

Results - The germination and growth rate in this area was exceptional. In one season a cover of 80% was achieved overall with minimum cover being no less than 15%.

Grasses were the main plants showing growth, with forbs, native and seeded next. A few shrubs were growing also.

SPRING 1982

Panel C

Methods - An area of approximately 10 acres that had been stripped of vegetation but not of topsoil or overburden, was seeded to prevent erosion. A rate of 24.8 lbs/acre was drilled with the rangeland drill.

Results - This area showed very good germination of native and planted species. After one seasons' growth a cover of 30% overall was achieved.

SPRING 1982

Panel C Topsoil Stockpile

Methods - After topsoil was removed from the Panel C mining area it was placed in a pile covering close to 2.0 acres. This stockpile was seeded with the rangeland drill at a rate of 24.8 lbs/acre.

Results - Germination of this area was very good. A few native species appeared but mainly a 30% cover of alfalfa and barley has appeared.

SPRING 1982

Roadside Areas

Methods - The roadsides to the office area approximately 3.0 acres, were smoothed, contours were placed on the slopes then the areas were seeded at a rate of approximately 24.8 lbs/acre with the rangeland drill.

Results - The growth in these areas was very limited. A few grasses germinated but few reached a height of more than 2" before trying to seed. Native Oxytropis plants were grow-

ing in one area.

SPRING 1982

Panel 1

Methods - Several study plots were prepared, seeded and outplantings set out to observe the effect of various planting mediums available on the property. Two plots of each; topsoil and Mackentire Tongue, were set up, 60' wide X 120' long, each divided into five 12' wide strips. The soil was graded, as cover on these plots, to a thickness of 3 to 9 inches.

The 5 strips consisted of hand broadcast shrubland seed mix, drilled shrubland seed mix, drilled grassland seed mix, outplanting with basins, and outplantings without basins. Three 48' wide X 60' long plots were made up of mixtures of tailings sand and overburden, tailings sand and Mackentire Tongue and tailings sand and topsoil. These were then divided into four strips, one of each seed mix drilled and two rows of outplantings with basins. Fertilization was done in randomly chosen vertical rows. The outplantings had an Agriform tablet placed near the root zone and the seed areas had prilled nitrogen broadcast and raked in. (See figure 4).

Results - All of the outplantings in the plots showed very good success. There was only about 3% mortality of all species planted. The drilled grassland mix did best in the topsoil plots but only poor results in the overburden plots. The drilled shrubland mix, which was broadcast, showed good results in all of the plots.

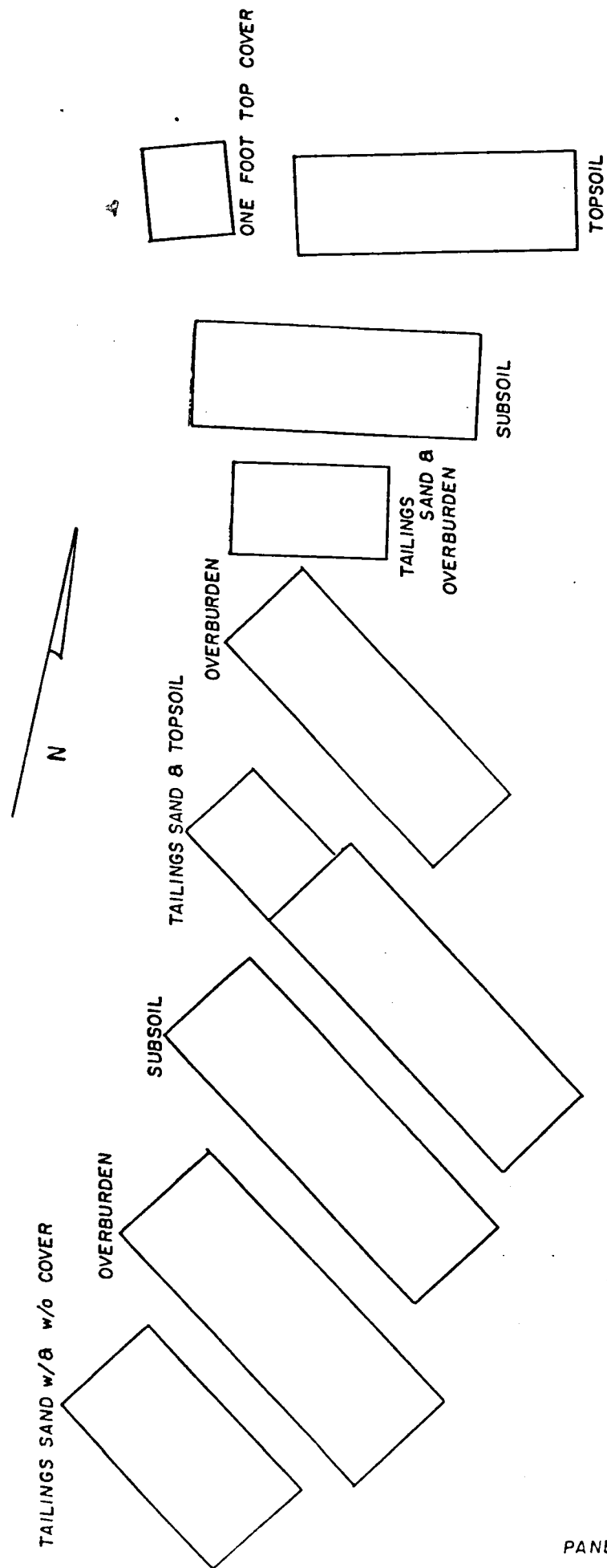


FIGURE 4
 PANEL 'I' STUDY PLOTS
 NO SCALE

SUMMER 1982

Area West of the Office

Methods - A demonstration plot was set up on approximately $\frac{1}{4}$ acre. The purpose of this plot was to show the types of plants available for use in reclamation on the property. Larger size outplantings were used in this area as well as broadcast grassland seed mix, so a final result could be obtained in a shorter amount of time. The area directly above the demonstration plot, approximately 6.0 acres, was drilled with the rangeland drill at a rate of 24.8 lbs/acre. An irrigation system was set which covered half of the demonstration plot and $\frac{3}{4}$ of the area above it.

Results - The demonstration plot is showing excellent results in all the planted and seeded species. The half that received irrigation has shown about twice as much vegetative growth. The area above the demonstration plot has achieved an 60% cover overall, this is mainly in cover crop, (barley), alfalfa, sweet clover, and Intermediate wheatgrass.

SUMMER 1982

Tailings Bench

Methods - This area is the same one that was seeded in the fall. Approximately 5.0 acres total was seeded at this time at a rate of 24.8 lbs/acre.

Results - This area was starting to show growth by the end of it's first season. The growth was limited but showed promise.

Brush Creek Topsoil Stockpile

Methods - This area was seeded in the fall but was disturbed when the study plots were set up. Approximately 1.0 acre was smoothed and reseeded at approximately 24.8 lbs/acre. This area was irrigated with a hose and rainbird sprinkler to get germination to occur as fast as possible and to make the conditions more favorable during the hot summer months.

Results - This area has had such good growth that it is undistinguished from the area surrounding it which was seeded in the fall of 1981. An 80% cover has been achieved.

FALL 1982

Brush Creek Fill Slopes

Methods - This area covered approximately 3.6 acres total with both sides. The seed mixture was broadcast with a cyclone seeder at a rate of approximately 30 lbs/acre. A straw mulch was applied by hand at a rate of 1 - 1.5 tons/acre. After this was done, a biodegradable mesh was placed over this and anchored in place with staples designed for this purpose.

Results - Not available.

FALL 1982

Brush Creek Haul Road

Area NE of Brush Creek Fill

Methods - Approximately 2.0 acres which were seeded in the fall of 1981, that had little success were reseeded after a layer of Mackentire Tongue was spread over the recontoured area. The seeding was done with the rangeland drill then a bio-degradeable

mesh and straw were placed in strips approximately every 50 feet to prevent excessive erosion.

Results - Not Available

Drainage Field

Methods - An area covering 0.75 acres was seeded with the rangeland drill. The edge of the area was hand seeded with shrub seed so blending of seeded and natural areas would occur.

Results - Not Available

Area NW of Office

Methods - The area between the substation and office approximately 2 acres, had Mackentire Tongue spread over it. The area was then scarified with the grader and seeded with the rangeland drill at a rate of approximately 32 lbs/acre. This high rate was used because the seed was left from the previous year. Sections of this area that were seeded in the summer were redone to remove erosion damage. These areas were also seeded at the higher rate.

Results - Not Available

Panel A

Methods - This area, the largest done to date, 54.6 acres, was smoothed, then covered in topsoil and Mackentire Tongue. The slope is greater than 3:1, so the seeding could not be done across the contour, instead the drill was run up and down the slope. The seeding rate used was 22.5 lbs/acre. After the area was drilled, contour ditches were placed across the

slope to prevent excessive run off.
These ranged from 20 to 90 feet apart,
depending on the steepness of the slope.
The contour ditches were then seeded by
hand using a cyclone seeder and the 1981
seed mix at a rate of approximately 30
lbs/acre.

Results - Not Available

Lower Panel A Below Fuel Dump

Methods - This area was smoothed then seeded with
the rangeland drill at a rate of 22.5
lbs/acre.

Results - Not Available

DISCUSSION

Reclamation in past years has had various results from which many different conclusions can be taken. The plantings of 1976 have shown that establishment of a plant community is possible on overburden without any soil cover. The main factors that govern plant establishment seem to be the angle of the slope, plant species and water.

Some species planted on steep slopes, such as Crested wheat and Siberian wheat, did very poorly, but when they were planted on a flatter area, in which infiltration of water could occur, they did much better. The Crested wheat, in combination with the Nomad alfalfa, has achieved an approximate cover of 80-90% in overburden, with little slope. Luna Pubescent wheat, Indian Ricegrass and Siberian wheat have also showed notable results in the same situation.

The plantings done by the Soil Conservation Service in 1978 show that a good cover can be achieved on steep slopes if they have a layer of topsoil or subsoil applied before seeding. The main purpose of this soil is for water retention, but the higher quantity of nutrients also help. Many species were shown to develop in these conditions but some did better when the slope orientation was varied. On the south facing slope, Lahonton alfalfa and Yellow Sweet Clover did poorly although they had done excellent on other areas. Beardless wheatgrass did excellent under these conditions, but in different plots with similar conditons but altering the orientation only moderate to good success resulted.

The Division of Wildlife Resources plantings of various species with different seed gathering locations was set up to show two main things, what major species grow with the existing conditions and does seed gathering site make a significant difference in plant development. Some of the seed planted of the same species and even the same variety had completely opposite growth results depending on the location of the seed collection. Basin Big Sagebrush, which was collected from Moab, had no success, but the same species collected

on Diamond Creek grew and did quite well. On Silky Milkvetch, the different collection areas made a difference in drought tolerance, some were drying out while others with conditons similar to the Vernal Operation, were doing exceptionally well.

4

The plots set up in 1979, were designed to show the effect on plant establishment from mulch and fertilizer application at the time of planting. Results of this study were surprizing as there was no significant increase in plant growth or establishment with the addition of fertilizer. On the other hand, mulch areas had increased establishment approximately 3 to 4 times over the untreated area when the grass mix was used. The shrub mix had much more dramatic results. One or two plants of Antelope Bitterbrush, Big Sage and Black Sage developed over the entire area which were untreated or treated only with fertilizer and thirty or forty plants were growing on the sections that had been mulched.

In reviewing past revegetation efforts of 1980, it was found that first year success is very limited because of growth of annual weed species, such as Summer Cypress and Russian Thistle; but, the second year the planted species increase substantially. Alfalfa, sweet clover, and milkvetch seem to be the first plants to get established. The reason probably being that they are deep rooted and don't have as much competition exerted on them by the annual weeds. These same results were noted in the 1981 seeding area.

Future revegetation of mined areas will be done with consideration of all previous work and study results taken into account. Past information and any accumulated in the future will be continually re-evaluated. The seed mix chosen for use will probably be very similar in all areas. A few additions or exclusions may be made depending on the specific site conditons, but a general seed mix can be found in Table I. This mixture contains bunch grasses, sod formers, deep and shallow rooted species, and drought and heat tolerant species. All of the species are good forage for wildlife and livestock over the course of the year, and something in the mix is always at a palatable stage.

TABLE I.

GENERAL SEED MIX

	<u>lbs/acre</u>
Crested Wheat	1.5
Intermediate Wheat	1.5
Siberian Wheat	2.5
Bearded Bluebunch	1.5
Beardless Bluebunch	1.5
Luna Pubescent Wheat	2.5
Indian Ricegrass	2.0
Cicer Milkvetch	.75
Ladak Alfalfa	.50
Yellow Sweet Clover	<u>.75</u>
	15.0 lbs/acre

Some of the adaptations which may be made to the seed mix include, but are not limited to: (1) increasing the Intermediate and Luna Pubescent wheatgrass percentages on steep slopes, to utilize the sod forming habit of these for slope stabilization, (2) increasing the Beardless Bluebunch percentage on south facing slopes and lowering the alfalfa and sweet clover, (3) the addition of shrub seed to the mix when the establishment of these species is particularly beneficial and mulching can be carried out.

Seed bed preparation will consist of the placing and smoothing of overburden, after which a layer of topsoil or subsoil will be put in place. If the overburden is compacted too much it will be lightly roughened to help infiltration of water and to prevent a barrier between the topsoil or subsoil and the overburden. The area will be seeded using a 10' wide Laird Rangeland drill where practical or a chest cyclone seeder in areas too small or too steep for the drill. Contour trenches will be added when needed to prevent excessive erosion and these will be seeded using the cyclone seeder.

Seeding will generally be conducted in the fall because of natural climatic factors, mainly moisture availability. Rates at which seed will be applied will be no less than 15 lbs/acre drilled and increased accordingly if conditions warrant. In this area,

the majority of moisture occurs in the winter as snow. To utilize this moisture, seeding will be prior to snow fall, thus it is there when the moisture is released by melting. If the seed is planted in spring it may not get this needed moisture and the germination and establishment will have more competition with annual weed species. The variation of seeding times may occur when supplemental water can be applied by irrigation

ACKNOWLEDGEMENTS

I would like to thank Howard Abplanalp, Ken Long and numerous other personnel at the Vernal Phosphate Operations, for all of the cooperation which I have received in collecting and writing all of this data.

APPENDIX I
SEED MIXES USED FOR RECLAMATION
AT THE
VERNAL PHOSPHATE OPERATION

Seed Species Used in 1976 Plantings

<u>Common Name</u>	<u>Rate/Acre</u>
Luna Pubescent Wheatgrass	8#
Siberian Wheatgrass	8#
Crested Wheatgrass	8#
Indian Ricegrass	2#
Nomad Alfalfa	2# w/grass

Seed Species Used in the 1978 DWR Planting Which Surrounds Plots

<u>Common Name</u>	<u>Rate/Acre</u>
Fairway Crested Wheatgrass	1#
Mtn. Big Sagebrush	2#
Fourwing Saltbrush	2#
Common Winterfat	2#
Rubber Rabbitbrush	2#
Orchard Grass	1#
Prostrate Summer Cypress	4#
Lewis Flax	1#
Alfalfa	1#
Yellow Sweet Clover	1#
Small Burnet	1#

Seed Species Used in 1978 DWR Plot Plantings

(No Quantities Available)

Shrubs

Antelope Bitterbrush
 Basin Big Sage
 Black Sage
 Common Winterfat
 Fourwing Saltbrush
 Mountain Big Sage
 Mountain Mahogany
 Mountain Rubber Rabbitbrush
 Shadscale
 Stansbury Cliffrose
 Wyoming Big Sage

Forbs

Blue Flax
 Eaton Penstemon
 Galegiformus Milkvetch
 Ladak Alfalfa
 Low Penstemon
 Nevada Showy Golden Eye
 Nomad Alfalfa
 Oneflower Helianthella
 Palmer Penstemon
 Rambler Alfalfa
 Sicklepod Milkvetch
 Silky Milkvetch
 Small Barret
 Yellow Sweet Clover

Grasses

Bearded Bluebunch Wheatgrass
 Bottlebrush Squirreltail
 Crested Wheat (Fairway)
 Great Basin Wildrye
 Indian Ricegrass
 Orchard Grass
 Scabulosa Wildrye

Beardless Bluebunch Wheatgrass
 Crested Wheat (Desert)
 Giant Wildrye
 Hard Sheep Fescue
 Intermediate Wheatgrass
 Russian Wildrye
 Streambank Wheatgrass

Seed Species used in 1978 SCS Plantings

<u>Common Name</u>	<u>Lbs/Acre</u>
<u>Unit #1</u>	
Whitmar Wheatgrass	10#
Lahonton Alfalfa	UNKN
Yellow Sweet Clover	UNKN
<u>Unit #2</u>	
Sodar Wheatgrass	16#
Lahonton Alfalfa	UNKN
Yellow Sweet Clover	UNKN
<u>Unit #3</u>	
Control	
<u>Unit #4</u>	
Basin Wildrye	10#
Lahonton Alfalfa	UNKN
Yellow Sweet Clover	UNKN
<u>Unit #5</u>	
Indian Ricegrass	10#
Ladak Alfalfa	UNKN
Yellow Sweet Clover	UNKN
<u>Unit #6</u>	
Luna Pubescent Wheatgrass	20#
Lutana Milkvetch	10#
Yellow Sweet Clover	UNKN
<u>Unit #7</u>	
Greenar Intermediate Wheatgrass	10#
Ladak Alfalfa	UNKN
Yellow Sweet Clover	UNKN
<u>Unit #8</u>	
Sherman Wheatgrass	6#
Sodar Wheatgrass	16#
Ladak Alfalfa	UNKN
Yellow Sweet Clover	UNKN
<u>Unit #9</u>	
Tegmar Wheatgrass	10#
Lahonton Alfalfa	10#
Yellow Sweet Clover	UNKN

'79 SCS Plantings (Cont.)

Unit #10

Tegmar Wheatgrass	10#
Lahonton Alfalfa	15#
Yellow Sweet Clover	UNKN

Unit #11

Luna Pubescent Wheatgrass	20#
Lahonton Alfalfa	UNKN
Yellow Sweet Clover	UNKN

Seed Species Used in 1979 Plantings

<u>Common Name</u>	<u>Rate/Acre</u>
Grass and Forb Mix	
Streambank Wheatgrass	4#
Luna Pubescent Wheatgrass	3#
Intermediate Wheatgrass	2#
Bluebunch Wheatgrass	4#
Russian Wildrye	4#
Indian Ricegrass	3#
Lahonton Alfalfa	3#
Yellow Sweet Clover	2#
	<hr/> 25 lbs/acre
<u>Brush Mix</u>	
Common Winterfat	2#
Big Sagebrush	3#
Black Sagebrush	1#
Stansbury Cliffrose	3#
Prostrate Summer Cypress	1#
Antelope Bitterbrush	3#
	<hr/> 13 lbs/acre

Seed Species Used in 1980 Plantings

<u>Common Name</u>	<u>Rate/Acre</u>
Streambank Wheatgrass	2.5#
Luna Pubescent Wheatgrass	2.5#
Whitmore Wheatgrass	2.5#
Indian Ricegrass	1.75#
Smooth Brome	2.5#
Cicer Milkvetch	2.5#
Ladak Alfalfa	2.5#
Lahonton Alfalfa	2.5#
Yellow Sweet Clover	1.75#
Prostrate Summer Cypress	1.75#
Fourwing Saltbrush	1.75#
	<hr/> 24.5 lbs/acre

Seed Species Used in 1981 Plantings

<u>Common Name</u>	<u>Rate/Acre</u>
Crested Wheatgrass	5.0#
Beardless Wheatgrass	5.0#
Intermediate Wheatgrass	5.0#
Ladak Alfalfa	3.0#
Yellow Sweet Clover	.6#
Cicer Milkvetch	5.0#
Common Winterfat	.5#
Stansbury Cliffrose	.2#
Prostrate Summer Cypress	.3#
Antelope Bitterbrush	.2#
	<hr/> 24.8 lbs/acre

Seed Species Used in 1982 Plantings
Brush Creek Fill (Steep Slope)

<u>Common Name</u>	<u>Rate/Acre</u>
Siberian Wheatgrass	4#
Rosana Western Wheatgrass	4#
Luna Pubescent Wheatgrass	4#
Greenar Intermediate Wheat	4#
Nordan Crested Wheat	2#
Nezpar Indian Ricegrass	2#
Ladak Alfalfa	2#
Yellow Sweet Clover	2#
Cicer Milkvetch	4#
	<hr/> 30 lbs/acre

Panel A & Misc. Areas

Siberian Wheatgrass	2.5#
Intermediate Wheatgrass	2.5#
Rosana Western Wheatgrass	2.5#
Pubescent Wheatgrass	3.0#
Nordan Crested Wheat	.75#
Whitmar Beardless Bluebunch	2.25#
Russian Wildrye	2.0#
Nezpar Indian Ricegrass	2.0#
Yellow Sweet Clover	1.0#
Cicer Milkvetch	3.0#
Ladak Alfalfa	1.0#
	<hr/> 22.5 lbs/acre

Seed and Plant Species Used in 1982 Study Plots

<u>Common Name</u>	<u>Rate/Acre</u>
<u>Grassland Seed Mix</u>	15#/acre drilled
Thickspike Wheatgrass	10#
Beardless Wheatgrass 4	20#
Intermediate Wheatgrass	10#
Western Wheatgrass	10#
Pubescent Wheatgrass	10#
Great Basin Wildrye	15#
Indian Ricegrass	15#
Alfalfa	8#
Yellow Sweet Clover	2#
<u>Shrubland Seed Mix</u>	18#/acre drilled 36#/acre broadcast
Beardless Wheatgrass	10#
Indian Ricegrass	15#
Cicer Milkvetch	9#
Common Winterfat	10#
Prostrate Summer Cypress	5#
Lewis Flax	5#
Munro Globemallow	2#
Big Sagebrush	1#
Fourwing Saltbrush	15#
Curl Leaf Mtn. Mahogany	10#
Rubber Rabbitbrush	3#
Antelope Bitterbrush	15#
<u>Outplantings</u>	
Fringed Sagebrush	
Black Sagebrush	
Curl Leaf Mtn. Mahogany	
Mountain Juniper	
Woods Rose	

APPENDIX II
PLANT SPECIES USED IN RECLAMATION
WITH
METHODS AND RESULTS OBTAINED

COMMON NAMES (Shrubs)	Soil Cover	Method	lbs/acre	Fertilizer	Mulch	Monoculture Or Mix	Slope	Results
Antelope Bitterbrush	Mackentire	Drilled	3.0	16-20-0/200#acre		Mix	S-SE	Poor
Antelope Bitterbrush	Mackentire	Drilled	3.0		Straw/unkn rate	Mix	S-SE	Good
Antelope Bitterbrush	Mackentire	Drilled	3.0	16-20-0/200#acre	Straw/unkn rate	Mix	S-SE	Good
Antelope Bitterbrush	Mackentire	Broadcast	Unkn			Mono	-	Good
Antelope Bitterbrush	Mac/OB	Broadcast	.2			Mix	S-SE	Poor
Antelope Bitterbrush	Mac/OB	Drilled	.2			Mix	S-SW	Poor
Basin Big Sage	Mackentire	Broadcast	Unkn			Mono	-	Poor
Basin Big Sage	Mackentire	Broadcast	Unkn			Mono	-	Poor
Basin Big Sage	Mackentire	Broadcast	Unkn			Mono	-	Moderate
Basin Big Sage	Mackentire	Drilled	3.0	16-20-0/200#acre		Mix	S-SE	Poor
Basin Big Sage	Mackentire	Drilled	3.0		Straw/unkn rate	Mix	S-SE	Moderate
Basin Big Sage	Mackentire	Drilled	3.0	16-20-0/200#acre	Straw/unkn rate	Mix	S-SE	Moderate
Basin Big Sage	Mackentire	Drilled	3.0			Mix	S-SE	Moderate
Black Sage	Mackentire	Broadcast	Unkn			Mono	-	Good
Black Sage	Mackentire	Broadcast	1.0	16-20-0/200#acre		Mix	S-SE	Poor
Black Sage	Mackentire	Broadcast	1.0		Straw/unkn rate	Mix	S-SE	Moderate
Black Sage	Mackentire	Broadcast	1.0	16-20-0/200#acre	Straw/unkn rate	Mix	S-SE	Moderate
Black Sage	Mackentire	Broadcast	Unkn			Mix	S-SE	Moderate
Bud Sage	Mackentire	Broadcast	Unkn			Mono	-	Poor
Fourwing Saltbrush	Mackentire	Broadcast	1.75			Mono	-	Good
Fourwing Saltbrush	Mac/OB	Drilled	Unkn			Mono	-	Good
Fourwing Saltbrush	Mackentire	Broadcast/harrow	2.0			Mix	-	Poor
Fourwing Saltbrush	Mackentire	Broadcast	Unkn			Mix	-	Good
Mountain Big Sage	Mackentire	Broadcast/harrow	2.0			Mono	-	Moderate
Mountain Big Sage	Mackentire	Broadcast	Unkn			Mix	-	Good
Mountain Mahogany	Mackentire	Broadcast	Unkn			Mono	-	Moderate
Rubber Rabbitbrush	Mackentire	Broadcast/harrow	2.0			Mix	-	Good
Rubber Rabbitbrush	Mackentire	Broadcast	Unkn			Mono	-	Moderate
Shadscale	Mackentire	Broadcast	Unkn			Mono	-	Moderate
Shadscale	Mackentire	Broadcast	Unkn			Mono	-	Moderate
Stansbury Cliffrose	Mackentire	Broadcast	Unkn			Mono	-	Good
Stansbury Cliffrose	Mackentire	Drilled	3.0	16-200-0/200#acre		Mix	S-SE	Poor
Stansbury Cliffrose	Mackentire	Drilled	3.0		Straw/unkn rate	Mix	S-SE	Poor
Stansbury Cliffrose	Mackentire	Drilled	3.0	16-200-0/200#acre	Straw/unkn rate	Mix	S-SE	Poor
Stansbury Cliffrose	Mackentire	Drilled	.2			Mix	S-SW	Poor
Stansbury Cliffrose	Mac/OB	Drilled	.2			Mix	S-SE	Poor
Stansbury Cliffrose	Mac/OB	Broadcast	Unkn			Mix	S-SE	Poor
Stansbury Cliffrose	Mackentire	Broadcast	Unkn			Mono	-	Moderate
Wyoming Big Sage	Mackentire	Broadcast	Unkn			Mono	-	Moderate

COMMON NAME *(Grasses)	Soil Cover	Planting Method	lbs/acre	Fertilizer	Mulch	Monoculture or Mix	Slope	Results
Basin Wildrye	Mackentire	Broadcast/harrow	10			Mix	E	Moderate
Big Bluegrass	Mackentire	Broadcast/harrow	6			Mix	E	Good
Bluebunch Wheatgrass	Mackentire	Broadcast	UNKN			Mono	-	Good
Bluebunch Wheatgrass	Mackentire	Drilled	4	16-20-0/200#/acre		Mix	S-SE	Good
Bluebunch Wheatgrass	Mackentire	Drilled	4		Straw/unkn rate	Mix	S-SE	Excell
Bluebunch Wheatgrass	Mackentire	Drilled	4		Straw/unkn rate	Mix	S-SE	Excell
Bottlebrush Squirreltail	Mackentire	Broadcast	UNKN	16-20-0/200#/acre		Mono	-	Moderate
Crested Wheat (Desert)	Mackentire	Broadcast	UNKN			Mono	-	Good
Crested Wheat	Overburden	Drilled	8			Mono	E	Poor
Crested Wheat	Overburden	Drilled	8			Mix	-	Good
Crested Wheat	Mac/OB	Drilled	5			Mix	S-SW	Good
Crested Wheat	Mac/OB	Broadcast	5			Mix	S-SE	Moderate
Crested Wheat (Fairway)	Mackentire	Broadcast/harrow	1			Mix	-	Good
Crested Wheat	Mackentire	Broadcast	UNKN			Mono	-	Good
Giant Wildrye	Mackentire	Broadcast	UNKN			Mono	-	Moderate
Great Basin Wildrye	Mackentire	Broadcast	UNKN			Mono	-	Good
Hard Sheet Fescue	Mackentire	Broadcast	UNKN			Mono	-	Good
Indian Ricegrass	Mackentire	Broadcast	UNKN			Mono	-	Moderate
Indian Ricegrass	Mackentire	Broadcast	2			Mono	-	Good
Indian Ricegrass	Overburden	Broadcast/harrow	10			Mix	-	Excell
Indian Ricegrass	Mackentire	Broadcast/harrow	3	16-20-0/200#/acre		Mix	S-SE	Excell
Indian Ricegrass	Mackentire	Drilled	3			Mix	S-SE	Moderate
Indian Ricegrass	Mackentire	Drilled	3	16-20-0/2--#/acre	Straw/unkn rate	Mix	S-SE	Good
Indian Ricegrass	Mackentire	Drilled	1.75		Straw/unkn rate	Mix	-	Moderate
Beardless Wheatgrass	Mac/OB	Broadcast	UNKN			Mono	-	Good
Beardless Wheatgrass	Mac/OB	Drilled	5			Mix	S-SW	Good
Beardless Wheatgrass	Mac/OB	Broadcast	5			Mix	S-SW	Moderate
Beardless Wheatgrass	Mac/OB	Drilled	2.5			Mix	-	Moderate
Beardless Wheatgrass	Mackentire	Broadcast/harrow	10			Mix	S-SW	Excell.
Intermediate Wheatgrass	Mackentire	Drilled	2	16-20-0/200#/acre		Mix	S-SE	Good
Intermediate Wheatgrass	Mackentire	Drilled	2			Mix	S-SE	Excell.
Intermediate Wheatgrass	Mackentire	Drilled	2	16-20-0/200#/acre	Straw/unkn rate	Mix	S-SE	Excell.
Intermediate Wheatgrass	Mac/OB	Drilled	5			Mix	S-SW	Good
Intermediate Wheatgrass	Mac/OB	Broadcast	5			Mix	S-SE	Moderate
Intermediate " (Greenar)	Mackentire	Broadcast/harrow	10			Mix	-	Good
" (Whitmore)	Mackentire	Broadcast	UNKN			Mono	-	Good
Luna Pubescent Wheatgrass	Overburden	Broadcast/harrow	8			Mono	-	Good
Luna Pubescent Wheatgrass	Mackentire	Broadcast	UNKN			Mono	-	Good
Luna Pubescent Wheatgrass	Mackentire	Broadcast/harrow	20			Mix	E	Good
Luna Pubescent Wheatgrass	Mac/OB	Drilled	2.5			Mix	-	Moderate

COMMON NAME *(Grasses)	Soil Cover	Planting Method	lbs/acre	Fertilizer	Mulch	Monoculture or Mix	Slope	Results
Luna Pubescent Wheatgrass	Mackentire	Drilled	3	16-20-0/200#acre		Mix	S-SE	Good
Luna Pubescent Wheatgrass	Mackentire	Drilled	3		Straw/unkn rate	Mix	S-SE	Excell.
Luna Pubescent Wheatgrass	Mackentire	Drilled	3	16-20-0/200#/acre	Straw/unkn rate	Mix	S-SE	Excell.
Orchard Grass	Mackentire	Broadcast	UNKN			Mono	-	Poor
Poa Spp.	Mackentire	Broadcast/harrow	1			Mix	-	Poor
Russian Wildrye	Mackentire	Broadcast	UNKN			Mono	-	Moderate
Russian Wildrye	Mackentire	Broadcast	UNKN			Mono	-	Good
Russian Wildrye	Mackentire	Drilled	4	16-20-0/200#acre		Mix	S-SE	Moderate
Russian Wildrye	Mackentire	Drilled	4		Straw/unkn rate	Mix	S-SE	Moderate
Russian Wildrye	Mackentire	Drilled	4	16-20-0/200#/acre	Straw/unkn rate	Mix	S-SE	Good
Sabulosa Wildrye	Mackentire	Broadcast	UNKN			Momp	-	Moderate
Siberian Wheatgrass	Mackentire	Drilled	8			Mono	-	Excell.
Siberian Wheatgrass	Overburden	Broadcast/harrow	8			Mono	E	Poor
Smooth Brome	Mac/OB	Drilled	2.5			Mix	-	Poor
Streambank Wheatgrass	Mackentire	Broadcast	UNKN			Mono	-	Good
Streambank Wheatgrass	Mackentire	Broadcast/harrow	16			Mix	E	Moderate
Streambank Wheatgrass	Mac/OB	Drilled	2.5			Mix	-	Moderate
Streambank Wheatgrass	Mackentire	Drilled	4	16-20-0/200#acre		Mix	S-SE	Good
Streambank Wheatgrass	Mackentire	Drilled	4		Straw/unkn rate	Mix	S-SE	Good
Streambank Wheatgrass	Mackentire	Drilled	4	16-20-0/200#acre	Straw/unkn rate	Mix	S-SE	Good

COMMON NAME * (Forbs)	Soil Cover	Method	lbs/acre	Fertilizer	Mulch	Monoculture Or Mix	Slope	Results
Blue Flax	Mackentire	Broadcast/harrow	1			Mix	-	Poor
Blue Flax	Mackentire	Broadcast	Unkn			Mono	-	Moderate
Cicer Milkvetch	Mackentire	Broadcast/harrow	10			Mix	E	Excell.
Cicer Milkvetch	Mac/OB	Drilled	2.5			Mix	-	Moderate
Cicer Milkvetch	Mac/OB	Drilled	5.0			Mix	S-SW	Excell.
Cicer Milkvetch	Mac/OB	Broadcast	5.0			Mix	S-SE	Excell.
Eaton Penstemon	Mackentire	Broadcast	Unkn			Mono	-	Moderate
Galegiformus Milkvetch	Mackentire	Broadcast	Unkn			Mono	-	Poor
Ladak Alfalfa	Mackentire	Broadcast	Unkn			Mono	-	Excell
Ladak Alfalfa	Mackentire	Broadcast/harrow	1			Mix	-	Good
Ladak Alfalfa	Mackentire	Broadcast/harrow	Unkn			Mix	-	Excell.
Ladak Alfalfa	Mackentire	Broadcast/harrow	Unkn			Mix	E	Good
Ladak Alfalfa	Mac/OB	Drilled	2.5			Mix	-	Excell.
Ladak Alfalfa	Mac/OB	Drilled	3.0			Mix	S-SW	Excell.
Ladak Alfalfa	Mac/OB	Broadcast	3.0			Mix	S-SE	Excell.
Ladak Alfalfa	Mac/OB	Drilled	2.5			Mix	-	Excell.
Lahonton Alfalfa	Mackentire	Broadcast	Unkn			Mix	S-SW	Poor
Lahonton Alfalfa	Mackentire	Broadcast	Unkn			Mix	E	Good
Lahonton Alfalfa	Mackentire	Drilled	3.0	16-20-0/200#acre		Mix	S-SE	Moderate
Lahonton Alfalfa	Mackentire	Drilled	3.0			Mix	S-SE	Moderate
Lahonton Alfalfa	Mackentire	Drilled	3.0	16-20-0/200#acre	Straw/unkn rate	Mix	S-SE	Moderate
Lahonton Alfalfa	Mackentire	Drilled	Unkn		Straw/unkn rate	Mix	S-SE	Moderate
Low Penstemon	Mackentire	Broadcast	Unkn			Mono	-	Poor
Nevada Showy Goldeneye	Mackentire	Broadcast	Unkn			Mono	-	Poor
Nomad Alfalfa	Overburden	Drilled	2.0			Mix	-	Excell.
Nomad Alfalfa	Mackentire	Broadcast	Unkn			Mono	-	Excell.
Oneflower Helianthello	Mackentire	Broadcast	Unkn			Mono	-	Moderate
Palmer Penstemon	Mackentire	Broadcast	Unkn			Mono	-	Moderate
Prostrate Summer Cypress	Mackentire	Broadcast/harrow	4.0			Mix	-	Good
Prostrate Summer Cypress	Mackentire	Drilled	1.0	16-20-0/200#acre		Mix	S-SE	Poor
Prostrate Summer Cypress	Mackentire	Drilled	1.0		Straw/unkn rate	Mix	S-SE	Moderate
Prostrate Summer Cypress	Mackentire	Drilled	1.0	16-20-2/200#acre	Straw/unkn rate	Mix	S-SE	Moderate
Prostrate Summer Cypress	Mac/OB	Drilled	1.75			Mix	-	Moderate
Prostrate Summer Cypress	Mac/OB	Drilled	.3			Mix	S-SW	Moderate
Prostrate Summer Cypress	Mac/OB	Broadcast	.3			Mix	S-SE	Moderate
Prostrate Summer Cypress	Mackentire	Broadcast	Unkn			Mono	-	Excell.
Common Winterfat	Mackentire	Broadcast	2.0			Mix	-	Excell.
Common Winterfat	Mackentire	Broadcast	Unkn			Mono	-	Good
Common Winterfat	Mackentire	Drilled	2.0	16-20-0/200#acre		Mix	S-SE	Poor
Common Winterfat	Mackentire	Drilled	2.0		Straw/unkn rate	Mix	S-SE	Moderate
Common Winterfat	Mackentire	Drilled	2.0	16-20-0/200#acre	Straw/unkn rate	Mix	S-SE	Moderate

COMMON NAME *(Forbs)	Soil Cover	Method	lbs/acre	Fertilizer	Mulch	Monoculture Or Mix	Slope	Results
Common Winterfat	Mac/OB	Drilled	.5			Mix	S-SW	Poor
Common Winterfat	Mac/OB	Broadcast	.5			Mix	S-SE	Moderate
Sicklepod Milkvetch	Mackentire	Broadcast	Unkn			Mono	-	Excell.
Silky Milkvetch	Mackentire	Broadcast	Unkn			Mono	-	Good
Small Burnet	Mackentire	Broadcast	Unkn			Mono	-	Poor
Small Burnet	Mackentire	Broadcast/harrow	1.0			Mix	-	Poor
Yellow Sweet Clover	Mackentire	Broadcast	Unkn			Mono	-	Excell.
Yellow Sweet Clover	Mac/OB	Drilled	1.75			Mix	-	Excell.
Yellow Sweet Clover	Mac/OB	Drilled	.6			Mix	S-SW	Excell.
Yellow Sweet Clover	Mac/OB	Drilled	.6			Mix	S-SE	Excell.
Yellow Sweet Clover	Mackentire	Broadcast/harrow	1.0			Mix	-	Good
Yellow Sweet Clover	Mackentire	Broadcast/harrow	Unkn			Mix	S-SW	Poor
Yellow Sweet Clover	Mackentire	Broadcast/harrow	Unkn			Mix	E	Good
Yellow Sweet Clover	Mackentire	Drilled	2.0	16-20-0/200#acre		Mix	S-SE	Moderate
Yellow Sweet Clover	Mackentire	Drilled	2.0		Straw/unkn rate	Mix	S-SE	Moderate
Yellow Sweet Clover	Mackentire	Drilled	2.0	16-20-0/200#acre	Straw/unkn rate	Mix	S-SE	Moderate

APPENDIX III
LIST OF PLANTS
BY
COMMON AND BOTANICAL NAMES

LIST OF SCIENTIFIC AND COMMON NAMES

<u>COMMON NAME</u>	<u>SCIENTIFIC NAME</u>
<u>GRASSES</u>	
Basin Wildrye	<u>Elymus cinereus</u>
Beardless Wheatgrass	<u>Agropyron inerme</u>
Big Bluegrass	<u>Poa ampla 'sherman'</u>
Bluebunch Wheatgrass	<u>Agropyron spicatum</u>
Bottlebrush Squirreltail	<u>Sitanion hystrix</u>
Crested Wheat (Desert)	<u>Agropyron deserotum</u>
Crested Wheat (Fairway)	<u>Agropyron cristatum</u>
Giant Wildrye	<u>Elymus giganteus</u>
Great Basin Wildrye	<u>Elymus cinereus</u>
Hard Sheep Fescue	<u>Festuca ovina 'duriuscula'</u>
Indian Ricegrass	<u>Orhyzopsis hymenoides</u>
Intermediate Wheatgrass	<u>Agropyron intermedium</u>
Luna Pubescent Wheatgrass	<u>Agropyron trichophorum 'luna'</u>
Orchard Grass	<u>Dactylis glomerata</u>
Sabulosa Wildrye	<u>Elymus sabulosa</u>
Siberian Wheatgrass	<u>Agropyron sibericum</u>
Smooth Brome	<u>Bromus inermis</u>
Streambank Wheatgrass	<u>Agropyron riparium</u>
Russian Wildrye	<u>Elymus junceus</u>
<u>FORBS</u>	
Blue Flax	<u>Linum lewisii</u>
Common Winterfat	<u>Ceratoides lanata</u>
Cicer Milkvetch	<u>Astragalus cicer</u>
Eaton Penstemon	<u>Penstemon eatoni</u>
Galegiformus Milkvetch	<u>Astragalus galegiformus</u>
Ladak Alfalfa	<u>Medicago sativa 'ladak'</u>
Lahonton Alfalfa	<u>Medicago sativa 'lahonton'</u>
Low Penstemon	<u>Penstemon humilis</u>
Nevada Showy Goldeneye	<u>Viguiera multiflora 'nevadensis'</u>
Nomad Alfalfa	<u>Medicago sativa 'nomad'</u>
Oneflower Helianthella	<u>Helianthella uniflora</u>

Common and Scientific names (cont.)

<u>COMMON NAME</u>	<u>SCIENTIFIC NAME</u>
Palmer Penstemon	<u>Penstemon palmerii</u>
Prostrate Summer Cypress	<u>Kochia prostrata</u>
Sicklepod Milkvetch	<u>Astragalus folcatus</u>
Silky Milkvetch	<u>Astragalus cibarius</u>
Small Burnet	<u>Sanguisorba minor</u>
 <u>SHRUBS</u>	
Antelope Bitterbrush	<u>Purshia tridentata</u>
Basin Big Sage	<u>Artemesia tridentata 'tridentata'</u>
Big Sage	<u>Artemesia tridentata</u>
Black Sage	<u>Artemesia nova</u>
Fourwing Saltbrush	<u>Atriplex canescens</u>
Mountain Big Sage	<u>Artemesia tridentata 'vaseyana'</u>
Mountain Mahogany	<u>Cercocarpus montanus</u>
Rubber Rabbitbrush	<u>Chrysothamnus nauseosus</u>
Shadscale	<u>Atriplex confertifolia</u>
Stansbury Cliffrose	<u>Cowania stansburiana</u>
Wyoming Big Sage	<u>Artemesia tridentata 'wyominensis'</u>

This page is a reference page used to track documents internally for the Division of Oil, Gas and Mining

Mine Permit Number M0470007 Mine Name Vernal Phosphate
Operator SF Phosphate Date April 4, 1984
TO _____ FROM _____

☐ CONFIDENTIAL ☐ BOND CLOSURE ☐ LARGE MAPS ☒ EXPANDABLE
☐ MULTIPUL DOCUMENT TRACKING SHEET ☐ NEW APPROVED NOI
☐ AMENDMENT ☐ OTHER _____

Description

YEAR-Record Number

☐ NOI ☒ Incoming ☐ Outgoing ☐ Internal ☐ Superceded

Reclamation Prior 1983

☐ NOI ☐ Incoming ☐ Outgoing ☐ Internal ☐ Superceded

☐ NOI ☐ Incoming ☐ Outgoing ☐ Internal ☐ Superceded

☐ NOI ☐ Incoming ☐ Outgoing ☐ Internal ☐ Superceded

☐ TEXT/ 8 1/2 X 11 MAP PAGES ☐ 11 X 17 MAPS ☐ LARGE MAP

COMMENTS: _____

CC: _____